A PLAN OF A COURSE OF CHEMICAL LECTURES,

BY

FRANCIS JOHN HYDE WOLLASTON,
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JACKSONIAN PROFESSOR
IN THE
UNIVERSITY OF CAMBRIDGE.

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MDCCXCIV.

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Art 16. The different opinions concerning Heat may be reduced to 2 general ones

1. That it is a material fluid.

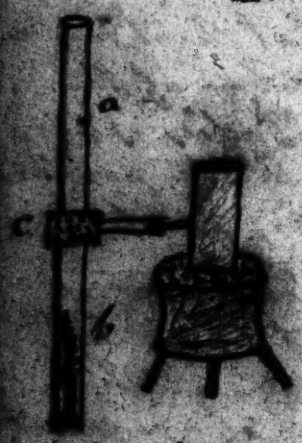
2. That it is only an affection of the particles of the Body.

The former is divided into 2. 1st Stahl's Opinion that the material fluid of heat is loosely united to Bodies in its fixed state it is sensible, & also that it becomes a constituent part of ye Body in its state he calls it phlogiston. 2d Lavoisier, who has destroyed Stahl's Doctrine of phlogiston supposes heat to be a material fluid to which he gives the name of a calorique but that it is not a constituent part of the Body.

The 2d general opinion that heat consists in a rapid intestine Motion of the minute ~~parts~~ particles of Bodies is rendered probable ~~by the~~ from the production of Heat by agitation, friction &c Exp. A small bar of Iron may be struck on an anvil till it be red hot. Hence a good workman will keep up for some time the heat of a piece of Iron by the rapidity of his blows. as it is particularly the case in the making of Anchors. — The above Exp. cannot be satisfactorily accounted for except on the latter Theory. — Count Rumford relates the boiling of water by ye Heat occasioned by the mere boring of Common

Art 12. Professor Wollaston covered an oven with charcoal by wh. ½ ye Quantity of fuel used to heat it was saved. —

Count Rumford concludes from several experiments that Water is a non-conductor of heat: — however, the following expt was made by the professor to shew that water does transmit the as a rare Body slowly;



Cold water was put into each of the ~~[illegible]~~ glass jars a & b, & within c a hollow perforated tin vessel contiguous to the water in each jar steam was forced by means of the vessel d; a system of Thermometers was placed within the vessels b each ½ an inch below the other — the heat descended gradually thro the water in the lower vessel; after a time the higher thermometer began to descend while the lower continued to rise. the water was put into each of the vessels at 50°, & when examined that in the

upper vessel had the temperature of 112°
while that in the lower was between
60° & 61°. —

Art 22. — Water contracts by cold
like other bodies till it arrives at 40°
then it seems to be stationary till about
34° when it expands: below 32° it ex=
=pands very sensibly. —

Black Lead considerably not to be used in
fusion of Salts

INTRODUCTION.

1. DIFFERENT definitions of Chemiſtry.
2. Hiſtory of Chemiſtry and Alchemy.
3. Arrangement to be uſed in a Courſe of Lectures.

The Chemical apparatus and uſes.

The general effects of heat.

General effects of mixture.

Effects on particular objects.

Diviſion and Order in which the Objects are treated.

				Art.
Mineral	Salts	Alkali	Soda	58
			Potaſh	60
			Ammonia	62
		Acid	Sulphuric	66
			Nitric	94
			Muriatic	116
			Boracic	136
			Fluoric	140
	Water			143
	Airs			146
	Earths		Argil, Lime, Magneſia, Barytes, Silex	155
	Diamond			180
	Metals	perfect	Gold	196
			Silver	211
			Platina	224
		imperfect	Mercury	230
			Lead	246
			Copper	260
			Iron	274
			Tin	294

Division and Order in which the Objects are treated.				Art.
Mineral	semi-metals		Arsenic	305
			Antimony	316
			Bismuth	334
			Zinc	341
			Cobalt	349
			Nickel	354
			Manganese	357
			Wolfram	363
			Molybdæna	364
Vegetable	Products by fire			366
	Natural products		Gums	369
			Saccharine Juices	370
			Saline Products	373
			Fixed Oils	377
			Volatile Oils	383
			Resins	391
			Gum Resins	400
			Bitumens	402
			Farina	410
	Products by fermentation		Vinous	411
			Acetous	423
			Putrid	428
Animal				431

The CHEMICAL APPARATUS.

4. Vessels used in fusion, calcination, cupellation.

Crucibles, cupels, muffle.

5. Vessels for distillation, per ascensum, per descensum.

Alembics, refrigeratory, worm-tub.

Retorts, receivers, adopters.

6. Vessels for sublimation.

Matrasses, aludels.

7. Vessels used for solution, digestion, cohobation, and circulation.

Cucurbits, the pelican, Papin's digester.

8. Pre-

pistols

Paper No

blowpipe

extremity of blue flame = Hot

lime mortar white of egg or rag

Clay or bone dust test tube

8. Precipitation.

9. Filtration.

10. Furnaces of different kinds.

Simple, reverberatory, melting, cupelling, lamp, and portable furnaces.

11. Baths, water, vapour, ſand, capella vacua.

12. The forge, blowpipe, ſpecula, lenſes.

13. Fuel, coal, coak, charcoal.

14. Materials for conſtructing furnaces, crucibles, &c.

For coating and lining them.

15. Various lutes.

Of HEAT.

16. Opinions concerning the cauſe of heat.

17. The diffuſion of heat.

18. The different powers of bodies to tranſmit,

19. Or to contain heat.

GENERAL EFFECTS of HEAT.

20. 1ſt. Expanſion.

21. The invention of thermometers.

22. Of the equable or unequable expanſion of bodies.

 23. 2d. Flu-

23. 2d. Fluidity.

24. Various degrees of heat neceſſary for the fuſion of bodies.

25. Of the quantity of heat abſorbed by melting ſolids.

26. Of the ſenſible heat which emerges during the congelation of fluids.

27. The theory of latent heat.

28. 3d. Vapour.

29. The manner in which elaſtic ſteams are produced.

30. The heat of boiling water.

31. This heat influenced by preſſure.

32. The volatility and fixity of different bodies.

33. Proceſſes for ſeparating the ingredients of compound bodies founded on theſe properties.

34. 4th. Ignition.

35. 5th. Combuſtion.

36. Air neceſſary to this effect.

37. Some bodies burn with flame, others without flame.

38. Changes produced in the bodies.

39. Changes produced in the air.

40. The

5. If an ounce of lead be melted & submitted to the action of the Atmospheric air it will in time be reduced to a calx & in this state it will weigh no more that it did at first.

6. If Red Lead be submitted to the action of a strong acid a considerable quantity of pure air or oxygen will be produced.

7. Charcoal will undergo no combustion in any air except oxygen or atmospheric air which contains oxygen.

These facts are a strong proof in favour of the New Theory that the Calcination of Metals ~~by means of heat~~ is the addition, by means of heat, of oxygen to the original metals instead of a Subtraction from them of an unknown principle, Phlogiston, according to the old Theory: in favour of which Theory I made the following experiment, to shew that by uniting the calx of a metal with phlogiston the metal is reproduced in its metallic state — I put some red lead in a retort, surrounded the whole by a jar containing Hydrogen (which was conceived to be almost pure Phlogiston) & exposed the red lead to a strong glass lens in the focus of which it was reduced to its metallic state & the Hydrogen diminished; but this was not the

The following are the principal experiments & facts which tend to confirm the Atmospheric

1. If the air which is generated by the Combustion of Charcoal, be collected in a proper receiver, it is found to have the peculiar property of precipitating Lime water from a solution of it in water, so that this circumstance is a sure test of the presence of this air (carbonic acid air). in the production of this air it is absolutely necessary that either atmospheric air or one of its constituent parts oxygen, be present for.

2dly if a number of angular pieces of Char be put into a crucible & covered with sand to prevent the action of external air, & the whole exposed to any degree of heat, the Charcoal will come out as entire as when put in at first & no air will be generated by it while it is in fire. —

3. if an ounce of Red Lead + 25 grs of Char be mixed together in a crucible, the red calx of Lead will be reduced into its metallic form but will be 4 grs less than the original ounce by 73 = the Charcoal during this process, will be consumed & a Quantity of air produced which precipitates lime water.

4. If the same Quantity of red lead, without the Charcoal, be submitted to the action of fire in the same manner as in the last experiment, no air will be generated

(upon the next page)

Act 20 According to the old Theory Phlogiston was considered as a principle something necessary to the existence of Metals in their metallic state but of which they were deprived by their during their Calcination & according to this Theory the calx of Lead was considered as a more simple substance than Lead in its metallic form in which it was considered as the calx of Lead united with Phlogiston.

The New Theory on much more substantial proofs, considers Metals in their metallic state as more simple than in their calcined state in which they are much heavier than they were before Calcination & this increase of weight is found to be in addition of pure air (oxygen) so that according to the old Theory a principle called Phlogiston was taken away from Metals during their calcination & according to the new Theory there was an addition made to them in the state of pure air or oxygen. — so proceeding

satisfactorily explained on the New Theory, as it may be proved that the union of Oxygen with Hydrogen produces water, since the Old Theory wants the supposition of something being lost while there was a manifest addition, & of something being added when there was a manifest diminution; and the circumstance of the Weight alone seems to give a just preference to the New Theory.

A 47. Instances of Simple Affinities

in moist way { Sulphuric Acid, Iron ..... or { Iron, Acid; Gallic Acid, Alkali }

in dry way { Sulphuret of Silver, Iron filings ..... or { Oxide of lead, Charcoal }

Instances of Double Affinities. 6.

in moist way { Sulphuric Soda ..... 10; Nitric Lime ..... 4 }

9

in dry way { Oxide of Lead, Soda; Sulphur }

in this case neither the Soda or Sulphur separately will decompose the oxide of lead, but jointly they will, going into the crucible 3

OF MIXTURE.

under 24th Art

OF

OF THE

OBJECTS

OF

CHEMISTRY.

SALTS.

50. DIFFICULTY of defining ſaline ſubſtances.

51. General properties of all, and the proceſſes founded on them.

52. Solution.

Aſſiſted by heat.

Cold produced.

Saturation.

53. Evaporation.

The pellicle.

Cryſtallization.

Vegetation.

54. Watery

1 & 1 oxide of lead, soda & sulphur, they also come out 3 & 1, Sulphuric Soda & lead.

Art 51. these will form a pellicle in generally are soluble in hot or cold water. —

Art 53 Salts crystalize best when the liquor in which they are dissolved is not neutral — some crystalize best when there with excess of Alkali; others, with excess of Acid. —

Art 65 If 2 salts be dissolved in the same water & one of them being $=^{ly}$ soluble in hot & cold water & the other more soluble in hot than in cold water, they may be separated from each other by boiling & cooling the solution, the former salt forming pellicles & the latter chrystals. —

Art 61. Potash cannot be distinguished from Soda when they are in solution

Acid plants yield most Potash

Art 64 [illegible]

2 [illegible]

Nitre containing red oxide of mercury

caution in this, just that quantity of oxygen as is sufficient to unite with hydrogen & heat is not by sufficient to disengage the oxygen from the oxide

Art 64 — 2d ~~Made~~ Method of decomposing ammonia — by passing it in its aeriform state thro'

The Synthesis of Ammonia may be shown by driving nitrous Acid thro' a red hot gun barrel filled with Charcoal, combining with the oxygen of the Acid & of its water the Azote of the Acid & the hydrogen of the water unite & come out as Ammonia.—

The other two alkalis have not been analyzed but it is probable that they are compounds formed during Combustion since by any

54. Watery fusion, spontaneous calcination and decrepitation, of salts.

55. The separation of different salts, by crystallization or sublimation

56. Division of saline substances into alkaline, acid and neutral salts.

ALKALINE SALTS.

57. Their general properties.

58. Soda—ol. mineral fixed alkali.

59. The method of obtaining it from sea plants.

Its crystals.

Its uses.

60. Potash—ol. vegetable fixed alkali.

61. Obtained from wood-ashes, from tartar, &c.

Properties which distinguish it from soda.

Its uses.

62. Ammonia—ol. volatile alkali.

63. Produced from animal substances.

Its distinguishing properties.

Its uses.

64. The analysis of ammonia, and its constituent parts.

ACIDS.

ACIDS.

65. General properties of acids.

The SULPHURIC ACID.

66. Obtained from ſulphur by combuſtion.

The ſulphurous acid—ol. volatile ſulphureous acid.

The ſulphuric acid—ol. vitriolic.

67. Concentration and rectification of this acid.

68. Its colour, ſpecific gravity and obvious properties.

69. Natural hiſtory of ſulphur.

Native ſulphur.

70. Purification and flowers of ſulphur.

71. Sulphur combined with the fixed alkalies in the humid and in the dry way.

Sulphuret of alkali—ol. alkaline hepar ſulphuris.

72. Sulphuret of ammonia—ol. volatile tincture of ſulphur.

73. Sulphuret of lime—ol. earthy liver of ſulphur.

74. Precipitate from the preceding ſolutions.

75. Sulphur combined with ſpirits of wine by Lauragais' method.

76. Sulphur diſſolved in oils.

77. Sulphur

other Analysis of vegetables we get little or no fixed Alkali. —

Art. 66 The redness, occasioned by adding the Sulphurous Acid to blue infusions of vegetables, soon vanishes

Art 76 a Dangerous & useless preparation

77. Sulphur obtained from pyrites by diſtillation.

Ferrugineous reſiduum.

78. Natural hiſtory of the pyrites.

79. Green vitriol obtained from pyrites deſulphurated by roaſting.

From pyrites in a ſtate of ſpontaneous efflorescence.

80. Green vitriol purified from copper.

81. Green vitriol calcined to a white, yellow, and red colour.

82. Calcined green vitriol analyzed by diſtillation.

Sulphuric acid.

Colcothar.

Sulphuric Acid combined with Water and Alkalies.

83. Strong attraction of this acid for water.

Heat produced.

Mixed with ice or ſnow produces cold.

84. The bulk and ſpecific gravity of a mixture of ſulphuric acid with water.

85. Neutral ſalt formed by the mixture of ſulphuric acid and an alkali.

Effervescence.

Tests of the neutrality of salts.

Proportion of acid and alkali in neutral salts.

The redundant acid or alkali rejected in crystallization.

86. Sulphuric soda—ol. Glauber's salt.

87. Sulphuric potash—ol. vitriolated tartar.

88. Sulphuric ammonia—ol. sal secret. Glaub.

Action of inflammable Substances on Sulphuric Acid.

89. Change of colour of sulphuric acid on addition of inflammable matters.

Pellucidity restored.

Sulphuric acid air.

Sulphureous vapours.

Sulphur.

90. Mixture of sulphuric acid and oil of turpentine.

Inflammation of the vapour.

Artificial resin distilled.

Sulphurous acid.

Sulphur.

Caput mortuum.

91. Sulphuric

89. by ~~two~~ few drops of sweet oil + sub^c Acid + heat
copper received ~~the~~ over mercury

Art 92. In vacuo water boils at a temperature below that at which water freezes. —

Art 94. Any sulphuric Acid is may some over & detected by the Muriate Baryte — & any muriatic Acid is detected by Nitrate silver —

91. Sulphuric acid mixed with rectified ſpirit of wine.

Heat, &c.

The mixture diſtilled.

Sweet ſpirit of wine.

Æther. yellowish Drops when following begin to come over

Sulphureous vapour and acid.

Oil of ſpirit of wine.

Artificial reſin.

Sulphur.

Caput mortuum.

92. Rectification of æther.

Its ſpecific gravity, volatility and inflammability.

Cold produced by the evaporation of æther.

93. Sulphur re-produced from ſulphuric ſalts.

The NITRIC ACID.

94. Nitre diſtilled with ſulphuric acid, with vitriol, ſand, clay, &c. 3 pts of clay

The nitrous—ol. red fuming nitrous acid.

And nitric acid—ol. white or dephlogiſticated trous acid.

 95. Specific

95. Specific gravity, volatility, colour and obvious properties of these acids.

96. Purification of nitric acid.

97. Natural history of nitre.

Crude nitre extracted from nitrous earth.

Purification of crude nitre.

98. Nitric soda—ol. cubic nitre.

99. Nitric potash—nitre or regenerated nitre.

100. Nitre melted in a gentle heat and fixed in cooling.

101. Nitre kept for a long time in a strong heat, or distilled without addition.

Air produced.

Alkaline residuum.

102. Detonation of nitre with charcoal.

103. Nitre detonated with sulphur in various proportions.

104. Detonated with tartar. in = 2 tes

White and black flux.

105. The invention of gunpowder.

The composition of it, and best proportion of its ingredients.

Theory of its explosion.

106. The

Art 96 from the Muriatic A^d by Silver
Silver. →

Art 106. —

Nitre — —	75	} to in 100 parts of Gunpowder
Charcoal — —	10	
Sulphur — —	15	

Soft woods make the best Charcoal for ~~chemical purposes~~ Gunpowder, hard woods for chemical purposes. —

By the new method of making Charcoal in close vessels $\frac{1}{3}$ of the charge is saved 2 parts going as far as 3. —

Force of Gunpowder calculated to be = to 56,000 Atmospheres. —

Hence
Art. 113. Nitric Acid & Ammonia convertible into each other. — see Art 64.

Art 109 Nitrous air produced by adding copper to dilute Nitrous Acid — if the Acid be not diluted the red nitrous vapours are produced. —

Art 110 Oil of Turpentine 3 pints.
Sulphuric Acid 1 pint. —
Nitrous A. strong, little more than 1 pint, mixing the sulphuric Acid with the Oil first & then adding the Nitrous A, this being Gray's method.

106. The decompoſition of gunpowder.

Nitre extracted from damaged gunpowder,

107. Pulvis fulminans. Nos 1 1. Potash 2.

Its preparation and properties.

108. Nitric ammonia.

Action of inflammable Subſtances on Nitric Acid.

109. Change of colour of nitric acid on addition of inflammable matters.

Nitrous acid.

Red nitrous vapour.

Nitrous air. 44 oz

110. Effects of heat and light on nitric acid. azote-united by electric sparks in syphon

111. Effects of heat on nitrous acid.

112. Nitrous acid mixed with water.

Heat and change of colour.

Red fumes.

Mixed with ſnow or ice produces cold. freezing Mixt

113. Of the conſtituent parts of nitric acid.

114. Nitric acid mixed with oils.

115. Nitric acid mixed with ſpirit of wine.

Nitrous æther.

The

The MURIATIC ACID.

116. The acid produced by diſtilling ſea-ſalt with ſulphuric acid, with vitriol, clay, ſand, &c.

117. Purification of the muriatic acid.

118. The ſpecific gravity, volatility, colour and obvious properties.

119. Muriatic acid air.

120. Muriatic ſoda—common or ſea-ſalt.

121. Natural hiſtory of ſea-ſalt.

Preparation of ſea-ſalt, from ſea water, ſprings and rock-ſalt.

Its impurities.

Attraction of ſea-ſalt for water.

122. Diſtillation of ſea water.

Teſts of the purity of diſtilled ſea water.

123. The decompoſition of ſea-ſalt.

Method of obtaining its alkaline baſe pure.

124. Muriatic potaſh—ol. ſal febrifugus ſilvii.

125. Muriatic ammonia—ſal ammoniac.

126. Natural hiſtory of ſal ammoniac.

Preparation of it in Egypt.

In Europe.

Its purification.

Acid 100 fm 3 parts of Sulphuric
Acid & 5 of common salt in retort &
Balloon &c :

To 6 parts of salt by weight add
5 parts of ~~[illegible]~~ Sulphuric Acid the
water being $\frac{1}{4}$ of the weight of the salt
so is about 2 of the strong Acid to 3 of
the salt &c

Art. 126 — In the large way it is made by distilling ammonia from Bones & other animal matters & receiving it into a dilute solution of sulphuric Acid; to this when saturated common salt is added & the Muriatic Ammonia is formed by a double Decomposition: on the same principle it is made at Newcastle on Tyne by mixing together both the Salts for in both cases

Sulphuric Ammonia
Muriatic Soda

Art 127 4 oz of Water + 11 drachms of this salt will sink the thermometer 40°. —

Art 130 — the best ::n of the ingredients for making it, is 6 parts of common salt & 2 of water mixed well with 2 or 3 parts of pulverized Manganese adding 5 of Sulph^c Ac diluted with ¼ of its weight of water.—

On the left is a simple app= ratus for making the Ox M^n A^d, a b, being a glass tube passing th a cork in the neck of the glass Bottle is used for the purpose of ~~[illegible]~~ ~~[illegible]~~ preventing the absorption of water on the cooling of the gas which not to be collected over Mercury as it corrodes it immedi= ately — with nitrous air it forms the Nitrous & Nitric Acids both of wh are soluble by water — with the oxygenous carbonated hydrogen or the

127. Properties of ſal ammoniac.

Its volatility, ſolubility in water, and ſpirits of wine.

Cold produced.

128. Sal ammoniac decompoſed by various methods.

129. The effects of muriatic acid on water and oils.

130. Oxygenation of the muriatic acid—ol. dephlogiſticated marine acid.

Properties of oxygenated muriatic acid.

Its uſes.

131. Oxygenated muriatic acid combined with alkali.

132 Oxygenated muriatic acid mixed with oils, with ſpirit of wine.

Muriatic æther.

MIXTURES of ACIDS.

133. Nitro-muriatic acid—ol. aqua regia.

Its properties and uſes.

134. Sulphuric acid impregnated with nitrous vapour.

135. Nitro-ſulphuric acid—aqua reginalis.

Its properties and uſe.

BORACIC

BORACIC ACID.

136. The acid ſeparated from borax by ſublimation and cryſtallization.

By the ſulphuric, &c. acids.

The reſidua examined.

137. Properties of the acid—ol. ſedative ſalt.

138. Natural hiſtory of borax.

Its purification and properties.

139. Vitrification of borax.

Solution and cryſtallization of the glaſs.

Uſes of borax.

FLUORIC ACID.

140. The acid obtained from fluor ſpar

By the ſulphuric, &c. acids.

141. Properties of fluoric acid.

Fluoric acid air.

142. Natural hiſtory of fluor.

WATER.

143. Of the impurities of ſpring and other waters.

144. Methods

which comes over in the making of ether it lets go the oil contained in that air, forming water with the hydrogen. — but with the simple carbonated hydrogen it explodes. — with sulphurated hydrogen it deposits sulphur. with phosphorous a slow combustion takes place.

Art 132 by distilling it in the state of vapour thro' Spirits of Wine. —

Fluor will bring into fusion $\frac{1}{4}$ of its weight of Lucanite

72 : 146 : 480 : x = 306 grns

Lin 18 : 10

11 $\frac{1}{2}$ parts of Hydrogen — Oxe 2.55

1 Dry = 320 grns

Art. 146 a pint of it weighs 13.2 grains

260 grns produced of water

Art. 147 a pint of it weighs 16 $\frac{1}{2}$ grains

15 Oxe 28 grns

406 grs of oxygen in ounce of water

144. Methods of analyſing mineral waters.

145. The conſtituent parts of pure diſtilled water.

72 grs 72 parts of H from 100 of water

410 grain

A I R S.

grs

100 oz — 320

146. Atmoſpheric air.

The different airs of which it conſiſts, and their proportion.

Teſts of the purity of air. 8 of O from 3 of sulphur burning

Eudiometers. Mr Scheele's method

147. Oxygen air—ol. dephlogiſticated, or vital air.

Its properties and effects.

148. Combination of oxygen air with nitrous air.

149. Sulphur combined with oxygen air.

Sulphuric acid.

150. Charcoal combined with oxygen air.

Carbonic acid air—ol. fixed air.

Its properties.

The re-production of charcoal from it by analyſis.

151. Azotic air—ol. phlogiſticated air.

Distinguished from fixed air by its not rendering lime water

 152. Hy-

152. Hydrogen air—ol. inflammable air.

Its production and properties.

153. Hydrogen air combined with ſulphur—ol. hepatic air. separately not absorbable by water

154. Solution of ſpirits of wine, &c. in hydrogen air. burning with a brighter flame than the hydrogen alone

EARTHS.

155. Characteriſtics of earths. not sol in W.

156. Argil, its properties—ol. clay. hardening in fire

157. Sulphuric argil—ol. alum. Comb of Sul A with clay

Analyzed by diſtillation or precipitation.

158 Natural hiſtory of aluminous ores.

The preparation of alum.

Its purification, properties, and uſes.

159. Calcination of alum with inflammable matters. takes fire

Homberg's pyrophorus. takes fire on exposure to air

Various pyrophori.

160. Properties of chalk and other calcareous minerals.

Circumſtances attending their ſolution in acids.

161. Calcination of chalk.

Lime. & attracts fixed air rapidly

Attraction of lime for water.

Heat.

Art. 102. — a pint of it weighs 1 grain. —

not fusible by themselves
easily fus. in the E. not fus. in pot ash

3 pt of Alum 1 of Sugar dried over a fire
not to break it in drying

increase of Wt in Com.
not Tile alone and as a test
this Tray 2 lb Reflector
of Wt in Lab air
alcalies the lime not act on acid
turnsole not give green with weak acid test of lee-ye

Brass & lime its appearance under blow pipe & when thrown into water

Art 136 Large ~~works~~ alum-works between Scarborough & Whitby

Art 162 with lime they produce heat but no effervescence, with carbonat of lime an effervescence but no heat; the effervescence being ∴ by driving off the Carbonic Acid: according to the doctrine of latent heat there is no heat in the latter case ∴ it is taken off by the va=pors. —

Art 165 If caustic ammonia be mixed with Spirits of wine there will be no pre=cipitate; but if the mild be used the ma=gnesia becomes opaque & thick & sometimes to concrete as not to run out of an inverted glass. —

Earths near in its properties wth Earths, fixed air w^h is to be driven off by H &c. / sol in Sulph^c Acid then called Epsom salt / not pre=cipitated by acet of Sugar as lime & other ect.

170 more sol when powder than when in its simple state in in w^r it differs obviously from lime w^h is almost insol when aerated

Heat.

Lime-water.

162. The action of acids on chalk and on lime.

163. Comparison of the effects of chalk and of lime, on sulphur, &c.

164. Decomposition of ammoniacal salts by chalk or lime.

165. Comparison of the products by mixing them with lime-water, spirits of wine, &c.

166. Effects of lime and alkalies on each other.

167. Dr. Black's theory of lime.

Carbonic acid air absorbed by lime and reproduced.

168. Sulphuric lime.

Plaster-stone, alabaster, gypsum, selenite.

The Bononian phosphorus.

Mr. Canton's artificial phosphorus.

169. Combination of lime with nitric or muriatic acid.

170. Magnesia, its properties compared with those of lime.

Its natural history, and production from the mother-water of nitre and sea-salt.

171. Sulphuric magnesia—ol. Epsom salt.

172. Barytes,

172. Barytes, obtained from the ponderous ſpar or cawk.

Its properties and affinity to ſulphuric acid.

173. Silex.

Inſoluble in acids, except the fluoric.

174. Fuſed with potaſh.

Liquor ſilicum.

175. Fuſed with ſoda.

Glaſs.

176. The invention of glaſs.

Ingredients in the different ſorts of glaſs.

The colour of glaſs.

177. Natural combinations of earths.

Talk, mica, aſbeſtos, ſoap-rock, &c.

178. Artificial combinations.

Earthen ware, porcelain, &c.

179. Of the vitrification of mixtures of earths, ſeparately unvitrifiable.

180. Of the diamond.

METALS.

181. The diſtinguiſhing properties of metals.

182. The native ſtate of metals.

Ores

Art 170 it is more sol when aerated than when uncombined in wr it differs obviously from lime wr is very insoluble when aerated. —

Art 172 Nitric Barytes shows the Sulc acid in Sulc Silver

for Materials for glazing 1pt of Quartz sand, 3/4 of Potash 2pt of Litharge of lead & 1 to 1 1/4 part of Calc of tin wr Cattle produces transparency Glass Ware is glazed by vapours of common Salt

Art. 600 Grains make a Troy ounce consisting of 160 Carats at 4 grains each carat —

The value of a Diamond is found by Xg the Number of Carats it weighs by 2, squaring that product

4 X 4 that square by 2 w gives it the value in £.

Art. 179 Any 3 of these earths together are vitrifiable if calcareous earth be one of them. —

Art 180 The largest known diamond belongs to the King of Portugal it weighs 1680 carats of w^h 150 make a Troy ounce, each carat being = to 4 grains; this diamond is alone 11 ounces: it is estimated to be worth 7,000,000 —

The value of an unwrought diamond is estimated by squaring the number of carats it weighs & multiplying by 2. — If cut you 2^ble the square & then multiply by 2. —

art.

B 2	460°	Compound bars	Compound bars
J 3	410°	the fuse separate	at 209° = 470°
L 5	540°		

Ores of metals.

The mineralizing ſubſtances.

183. The ſeparation of metals from their ores.

Aſſay and ſmelting of metals.

Their purification.

184. Sulphur combined with metals.

185. The fuſibility of metals.

The degree of heat at which they fix.

Their cryſtallization.

186. Fuſibility of metals combined with one another.

Solders, alloys.

Specific gravity of the mixtures.

187. Calcination of metallic ſubſtances

By heat and air.

By deflagration with nitre.

Increaſe of weight, and other properties.

188. Reduction of metals.

Loſs of weight.

189. Action of acids on metals.

Air produced.

190. Precipitation of metals by alkalies.

Increaſe of weight.

191. The precipitate reduced.

192. Precipitation by other metals.

193. Effects of alkalies, neutral ſalts, borax, &c. on metals.

194. Colour given to glaſs by metals.

Artificial gems, paſtes, enamels.

PERFECT METALS.

195. The diſtinction between perfect and imperfect metals.

GOLD.

196. Peculiar properties of gold.

197. Natural hiſtory of gold.

198. The method of ſeparating gold from ſand, earth, &c.

199. Action of heat and air on gold.

Of large burning glaſſes.

Of nitre.

Of lead.

Art. 192. according to the superior degree of affinity for Oxygen?

Phosphorous having a = affinity for Oxygen than Copper, precipitates it into metallic form from its solution in Sul^c Acid.—

Art. 194 by calc. of time whiteness & opacity on ac^n account this calc is made the basis of all Enamels.—

Art 196.— a wire of it $\frac{1}{10}$ of an inch in thickness will support 500 lb.— a single grain of it will spread under the hammer so as to cover 67 square inches.—

Art 199.— a portion of it suffered a melting = time whiteness from the action of Mr Richie's great lens the kept in fusion at different times for several days.—

Art 201. As to the Aurum fulminans see Macquer's Dictionary. —

neither act separately on Gold but jointly they do
Nitrous Acid will not dis Gold but by add of
Sol Alkalinae till Gold is dissolved / precip by
Salp Ether
Sol of Gold precip by Ammonia fulminating
amm consists of Hydrogen & calx of Gold con
tains Oxygen

Silver gives a Black stain always

~~to Nitrous~~

Lemon & Royal green O. 1pt salt 1pt 1pt 2 of Brun
Dust & Water

200. Action of acids on gold.

201. Gold diſſolved in nitro-muriatic acid.

Precipitated by alkalies. by ammonia

Aurum fulminans. by ammonia & Magnesia fulminans

202. Aurum fulminans deprived of its fulminating quality. by digesting it in oil, ether

203. The precipitates ſoluble in acids, &c.

204. Gold precipitated by metals.

By ſulphuric iron. in Dr Mac's paper for colour of Glass

By ſolution of tin—precipitate of Caſſius. with purple

205. Gold ſeparated from the ſolution by æther.

206. Action of ſulphur on gold.

207. The colour of gold affected by various ſubſtances.

208. Combinations of gold with copper, &c.

Alloys, ſolders.

Uſe of the touch-ſtone. common black flint

209. Gold refined by various proceſſes.

By dry parting. sep it from other metals by means of Sulphur

Cementation. = Wts nitre & Sul. Iron + 2 wt of black dust

Crude antimony.

Cupel-

Cupellation. by lead & addition of ars

Quartation. 1 3 pts of 1 of Gold

210. Gilding in various ways. is acted on by sulphuric acid

amalgam of Hg Mr sent off by heat

SILVER.

211. Peculiar properties of silver.

212. Natural history of silver.

Method of extracting native silver from earth, &c.

Silver extracted from its proper ores.

From ores of lead, &c.

213. Purification of silver from imperfect metals. by nitre to separate it from copper

214. Action of heat, or large mirrors on silver.

215. Action of sulphuric acid on silver.

216. Nitric silver crystallized and fused—ol. lunar caustic.

217. Muriatic silver fused—ol. luna cornea.

218. Silver precipitated from its solution by alkalies.

219. Reduction of the precipitate.

220. Precipitated by lime. for Nitric acid

Fulminating silver.

221. Pre-

last scum of litharge has the colours of the rainbow

if silver in small qty be in the mixture it is so envelopped in gold as not to acted on by the acid

by [illegible] learned

[illegible] on silver [illegible] water in salt

Art 215 Sulc Silver is a good test of Muriatic Acid

Art 216. A solution of it gives a black tinge to the skin.

Art 220 If a solution of Nitric Silver be precipitated by adding to it hydrogen and more lime water than is sufficient to precipitate the Silver, the precipitate will be in a state proper for making the fulminating silver; for in preparing it the precipitate be separated from the liquid & washed & dry the [illegible] lightly then take a grain of it & put it into a bottle which will hold about [illegible] of any liquid & put into it [illegible] of ammonia they been powder - mix without shaking the liquid at different times & at such times take care to surround the bottle with clothes to guard against accidents

The addition of the Muriatic Acid is a nice test of Selenium in the Solution & is the best way of getting pure selenium

Ar 230 is found native in Spain & Africa
in the clefts of rocks — if prune it does
not draw a tail with it — prunified by passing
it thro leather. —

221. Precipitation of silver by metals.

222. Silver united with sulphur.

223. Alloys of silver. Copper

Standard silver of England. 37 3 of Copper

PLATINA.

224. Natural history of platina.

Its properties.

225. Action of fire, nitre, and lead on platina. Metal

226. Platina dissolved in nitro-muriatic acid. A proper solvent

Precipitates from the solution. by

227. Action of sulphur on platina.

228. Action of arsenic on platina.

229. Purification of platina.

IMPERFECT METALS.

MERCURY.

230. Distinguishing properties of mercury. S. 1313

231. Natural history of mercury. S. 1314

Method of extracting it from its ores.

Purified by distillation.

232. A black powder obtained from mercury by agitation. S. 1315 is purified by this means

in a great degree

233. Mer-

233. Mercury changed into a red powder by ſlow calcination—calcinatus per ſe. S. 1316

Reduced by heat alone.

234. Mercury combined with ſulphuric acid—Turpeth mineral. S. 1318.

235. Nitric mercury cryſtallized. S 1328-9-32

The cryſtals urged by ſtrong heat—ol. red precipitate.

Red vapours.

Oxygen air.

Reduced mercury.

236. The ſolution of mercury in nitric acid diluted with water.

237. Precipitates from the ſolution by acids,

By alkalies, &c.

238. Muriatic mercury—ol. calomel.

239. Oxygenated muriatic acid combined with mercury—ol. corroſive ſublimate.

240. White, brown, &c. precipitates of mercury

By alkalies.

By lime-water—ol. aqua phagedenica.

By copper.

241. Combination of mercury with vegetable acids.

242. Mer-

Art. 234. a white oxide falls on dilution with cold water. This sulphate may exist in 3 different states 1 without of Acid. 2 neutral. 3 with excess of oxide. —

Art 235. The strength of the Acid makes a considerable alteration in the nature of the Solution. —

Art 238 – 9 GS 1838 – 9 – 40 – 5 – 647

Bisulph Cobalt water

Salpeter

100 grains of Mr to 1 1/2 oz of nitrous

Stirring mixture in 1 oz of W a precipitate decant off the liquor & dry the precipitate

Art 236. v Fourcroy p. 121-2-3.—
in this case the oxidation is incomplete but with heat & concentrated Acid it is complete & in this state the Nitric Acid becomes loaded with an excess of Mercurial oxide & forms into needle-like crystals on diluting pouring the solution into distilled water — but no such effect takes place on treating a solution of the perfect salt in the same manner. —
The solution of Nitrate of Mercury is used to ascertain the presence of Sulphuric & Muriatic salts in mineral waters. —

Art. 237. Those from the Nitrate of Mercury by carbonate of ammonia & lime water as well as that for the muriate of Mercury by lime water, fulminate when mixed with a small quantity of sublimed sulphur & exposed to heat. —

Art 239

A combination of this sort may be made by driving the Oxygen vapour through boiling mercury as is represented in the above apparatus, the retort containing ~~[illegible]~~ Salt Manganese & Sulph. Acid. — while the Mercury is kept boiling by a chafing dish of burning Charcoal placed below it —

242 the Combination put into a Vessel
salt & Manganess no Sul^c acid in one vessel
salt & Sul^c acid in another, fumes
from each conveyed into vessels each cont
bore combination in former vessel
M^n acid condens M^n, in latter no part
in solu. in M^n dissolved & only liter left
in latter M^n not taken into solu
though the acids recipr. decomp
on affinity

Lead — its fracture if small grain contains
silver than large grain

Phosphoric Acid is g. purity from phosphoric
lead ore

lb lb
100 fibs 112 to 120 leg being converted
into red lead

A. 247 — 100 lb. of lead by being converted
into red lead is increased in weight from 112 to
120 lb. —

242. Mercury united with sulphur by trituration.

Or by fusion—oil. Æthiops mineral.

243. The mixture sublimed.

Factitious Cinnabar.

Vermilion.

244. Mercury triturated with grease, oil, gums, &c.

245. Metals combined with mercury.

Amalgams.

LEAD.

246. General properties of lead.

247. Natural history of lead ores.

248. Method of extracting the metal.

Lead volatilized by heat.

Granulation of lead.

249. Lead calcined.

Litharge, masticot, minium or red-lead.

Their fusibility, and action on earths, &c.

Their action on oils.

250. Lead reduced.

251. Action of sulphuric acid on lead.

 252. Action

COPPER.

Art. 252. Nitrate Lead is a tolerable good test of the presence of Sulphuric Acid & may be shown by the precipitate Acetate

Art 253

Litharg w^th = = W^t of Salt

when water is for cardy matter the separation can by complete –

white powder fused makes turners patent yellow

256 Boil fluor of Sulphur wth some lime makes a proper sulphuret for a test of the presence of sugar of Lead in white Wine. –

Art 256 Galena + dilute Sul^c A^d produces sulphurated hydrogen w^h when in union with water is shown by Acetate Lead

Art 256 Pulverized sulphuret of lead + dilute Sul^c A^d produces sulphurated hydrogen w^h when absorbed by water is shown by a solution of Acetate lead. –

268 or 9 n. dissolves the precipitate

for Sul. Copper by lime forms Verditer

At 268 ammonia a pretty good test of
the presence of ~~ammonia~~ Copper by
dissolving the precip. shewn with Sul. Copp.

The precipitate

At 269 by ammonia from Sul. Copper is
dissolved by excess of the alkali & this is
a very good test of the presence of Copp.
by forming with Acids a beautiful tur-
quoise blue solution.
The precip. by lime from Nitrate
forms the artificial mountain Blue
Verditer adding for 6 to 10 parts of quick
lime to 100 of the precipitate.

+ see Edwards's Scientific Memoranda for A.D. 1789

At 272 strongly recommend the
At 271. from excellent account of the
Method of making Spirits see Ed-
wards's Scientific Almanack for A.D. 178
Proof is made by distilling fermented
liquor with charcoal & Lapis calamin
— 100 parts of Proof consist of 60
of Liquor & 40 of Water.
At 272 as by burning Gold yield in a
crucible At 19. with 8 times its weight of Lead

Methods of extracting the metal.

Purified by repeated fusion.

262. Granulation of copper.

263. Copper calcined,

And reduced.

264. Sulphuric copper—ol. blue vitriol,

265. Nitric copper—ol. cupreous nitre.

266. Muriatic copper.

267. Preparation of acetic copper—ol. verdigris.

268. Action of alkalies on copper.

Test of the presence of copper.

269. Precipitations of copper,

By alkalies,

By lime,

By iron,

By tin.

270. Copper combined with sulphur.

271. Copper mixed with arsenic, tin, zinc, &c.

Speculum, and bell-metal, brass.

272. Brass changed into copper.

273. Lead separated from copper by eliquation.

IRON.

IRON.

Oct. 27 as in the deflagration of Steel filings with Nitre in hot crucible — If Iron filings or turnings be put into 2 bottles of distilled water one corked & the other open the iron in the former will be unaltered while that in the latter is considerably oxidated — shewing how much the air contained in water contributes to the rusting of Iron

Oct. 28th. by an alkali fusty Iron we at first green & of an ochrey colour by absorbing oxygen from the air — The degrees of oxydation of the Iron & state of the alkali used make a considerable difference in the colours of the precipitates — hence variation in Stable alkaline tinctures & hence if Iron be precipitated by the Gallic & from a fresh solution of green Vitriol a dark brown but not black precipitate is produced

but if it be precipitated by the same acid from a solution of Green Vitriol wch by standing some time exposed to the action of the air has changed from a green to reddish colour the precipitate will be black & proper to make Ink; the nature of the Sul^d Iron having been changed by its absorbing oxygen from the ~~atmospheric~~ atmospheric air. —

Art 28 C. Mr Scheele separated it by boil
a calx of Mercury with Prussian Blue
then adding filings of Iron & sulphuric
Acid — 2d latter takes the Iron & the Pr
-ic Acid is released having the smell of
Nuts or almonds. ——

28a union of this mixture w th deluted Sol A
produces Hepatic air.
Art 28a. an uncertain preparation
Art. 28

9 lt cooled in Mt color surface hard
inner soft — 2 or 3 hours increment makes
it hard to. = Depth.

2 lt : 10 of Citric deflagrated & result to th
heat in crucible makes a PA that will
immediately precip Iron of blue color with
any fixed having Iron in it

Ink and black dye.

Prussian blue.

285. Preparation of Prussian alkali for manufacture,

Or for chemical purposes.

286. Prussic acid separated and examined.

287. Sulphur combined with iron.

Artificial pyrites.

288. Iron, sulphur and water kneaded together.

Incension of the mixture.

289. Mixtures of iron with other metals.

290. Iron converted into steel.

Steel converted into iron.

Cast steel.

Steel tempered.

Iron case-hardened.

291. Steel dissolved in acids.

Plumbago—black lead.

Its properties, and natural history.

TIN.

292. General properties of tin.

293. Natural history of tin.

294. Ex-

294. Extraction of the metal from the ore.

Granulation of tin.

295. Tin calcined.

Putty.

Enamels.

296. Action of concentrated sulphuric acid on tin.

Diluted with water.

297. Action of nitric acid on tin. as required

Ammonia.

298. Muriatic acid combined with tin.

299. Oxygenated muriatic acid combined with tin—ol. liquor fumans Libavii

300. Tin dissolved in nitro-muriatic acid.

301. Action of vegetable acids on tin.

302. Tin combined with sulphur.

Aurum mosaicum.

303. Mixtures of tin with other metals.

Tinning of copper and iron vessels.

Tin plates.

SEMI-METALS.

304. Distinguishing property.

ARSENIC.

295

Art. its calx fuses into a semi vitreous opake with vitreous substance
Mass being the Basis of all the Enamels.—

Art 297 is so rapid when the Acid is not diluted
that ~~a white oxide~~ a nitrate of tin is not formed — a white
oxide & the gaseous oxide of Nitrate being produced

Art 299 made by rubbing together an amal-
gam of 1 of Mercury to 6 or 2 of tin, with an
equality of the whole of corrosive sublimate
& be perfectly dry when used for this
purpose — the result added to alcohol
= Dulcified & gently distilled a liquor
comes over from w. Muriate of tin may be
separated by lime water
[illegible] tin w th 1/2 its Wt of [illegible] + [illegible]
[illegible] sal ammoniac in glass bottles [illegible]

303 Tinning of iron — plates of iron cleaned &
put into pot tin fusing salt on
its surface
copper, tinned in a similar way

Art. 300 ~~on~~ so has been made by adding 2 parts of moderately strong nitric Acid to 1 part of concentrated Muriatic Acd; Mercury being added by in small portions at a time.

Art 301 Little or nothing is this method is irreconcilable proofs for calomel proves hence copper is found and to prevent the noxious effects of Copper.

Art 302 — by rubbing together 7 parts of flowers of Sulphur & 3 of Sal ammoniac with an amalgame made of 12 parts of Tin & 3 of Mercury & by very gentle sublimation; ~~Acc~~ If the process be carried on in a glass bottle with a long neck the results will be seen to advantage

Art 303 In the above process an oximuriate of Tin is formed by the decomposition of water in the Sal ammoniac — Aurum Mosaicum is used to give a gold colour to Metals — see Green Vol 2. p. 362, 3, 4.

Art 303. 2 parts of tin & 1 of Bismuth make Pewter in = parts

Bismuth Tin & Mercury make

argentum mosaicum

vid Green Vol 2 p 371

Tin combined with Lead & Antimony forms Pewter,

Two pieces of Iron may be united by soft solder provided they have been previously tinned

In the making of looking glasses the glass is to be kept always below the surface of the Mercury.

Art 306 Arsenical Pyrites contains this semi-metal combined with Iron & is called

Art. 308 the best way is by rubbing down with Charcoal the neutral salt mentioned under the 312th Art. & subliming from Retort the metal being more volatile than its oxide or white [illegible] oxygenated as it is in the state of Acid of Arsenic. Would [illegible] remains fixed in the fire but [illegible] deliquescent Arsenic turning into the neutral arsenical salt of Magnet [illegible] blow pipe without giving [illegible]

Art. 313 native in both states found near Quito & near Mount [illegible] Vesuvius, both states may be made either of oxided or regulus Arsenic — in equivalent [illegible] to of Sulphur, in Realgar [illegible] the [illegible] becomes transparent by fusion

one of the best remedies for poison of the is calcareous or Alkaline Sulphuret [illegible] of this sulphuret to begin in a pint of water — lime water sulphur waters are good in this case. [illegible] sulphuret of arsenic has been recommended as an antidote :: Sulphur deprives arsenic of its

ARSENIC.

305. General properties of white arsenic.

306. Natural history of the mineral substances, which afford arsenic.

307. Method of procuring arsenic from them.

Purified by sublimation.

308. Reduction of the metal—regulus of arsenic.

309. Metal calcined.

White arsenic. promotes very much the vitrification of earths, & used to glaze earthen ware

310. Acid of arsenic.

311. White arsenic dissolved in water, alkali, &c.

312. Nitre and arsenic distilled together. + m = 2es

Neutral arsenical salt.

313. Arsenic combined with sulphur. Volume made to be

Yellow and red arsenic—orpiment and realgar.

314. Arsenic united to metals.

Test of the presence of arsenic. as union with

315. Uses of arsenic.

In painting, pottery, &c.

ANTIMONY.

316. General properties of crude antimony.

317. Its natural history.

Method of extracting it from its ore.

318. Pure metal ſeparated from crude antimony.

Properties of pure antimony—ol. regulus of antimony.

319. Antimony calcined.

Vitrified. add with borax to produce a light colour

320. Deflagration of antimony with nitre. & tartar

321. Action of ſulphuric acid on antimony.

322. Of the nitric and nitrous acid.

323. Of the muriatic and nitro-muriatic acids.

324. Combination of the oxygenated muriatic acid with antimony.

325. Mixtures of antimony with metals.

And uſes of antimony.

326. Sulphur fuſed with antimony.

Crude antimony.

327. Crude antimony roaſted, calcined and vitrified.

328. Crude antimony deflagrated with nitre in various proportions—ol. crocus antimonii.

329. Crude antimony fuſed with alkali—ol. regulus medicinalis.

The compound diſſolved in water.

Spon-

Gossamers Penalities. —

Oct 318 By fusion with Tin, Copper, Silver or Iron. —
a beautiful stellated regulus made by the celebrated chemist Wöhler was shown at Mr Wollaston's Lectures. —

to produce a regulus — to be known as by degrees
to avoid ~~an~~ Detonation — mixed with a brass heat
& then powdered as so as ~~the~~ ~~[illegible]~~ [illegible]

Oct 323. the latter is the proper solvent of Platina

Pt
Corrosive Sublimate rubbed down with a
pure ~~[illegible]~~ or crystals — with very gentle heat
with nitric A. &c. &c. required
with crude A^n rose Lemon colour [illegible]

Art 328. — 1 of Nitre to 3 of Antimony forms the Crocus medicinalis

1 of Nitre to 2 of crude Antimony forms the Crocus antim — stronger than the former but called emptier in reference to the next as is stronger = pts of Nitre & Antimony, ye Crocus Metallorum & is on being boiled with water hydrogenated sulphuretted oxide is precipitated. —

2 of Nitre to 1 of Antimony forms the metreuma antimonii by being calined to a mass

3 of Nitre to 1 of Antimony forms the Calx Antimonii a preparation of little effect — by edulcorating this compound with water a white perfect oxide of Antimony is obtained, called the washed diaphoretic Antimony. —

Art 329. in the ::n of 6 of Ant to 1 of Nitre & is the same result as takes place in the reduction of crude antimony as mentioned under Art 318. —

Art 831. The fine metallic pigment called Naples Yellow is formed from 3 parts of white oxide of Antimony 12 of white oxide of lead, 1 of sulphate of alumine & 1 of muriate of ammonia & heated weakly for some hours & then kept in a red heat. —

Spontaneous precipitate—Kermes' mineral.

Sulphur precipitated by an acid—ſuphur auratum antimonii.

330. Separation of ſulphur by the action of acids on crude antimony.

331. Combination of oxygenated-muriatic acid with crude antimony —butter of antimony.

Rectification of the compound. by distl. slight Hft

A precipitation by dilution with water—pulvis algaroth. a more certain prepn of Ant than any other

332. Action of vegetable acids on antimony.

Antimonial wine.

333. Antimony combined with tartaric acid.

Tartar emetic.

BISMUTH.

334. General properties of biſmuth.

335. Natural hiſtory of biſmuth.

Separation of the metal from its ore.

336. Biſmuth ſublimed,

Inflamed,

Calcined,

Vitrified. in this state used as scorifier of Metals

337. Biſmuth deflagrated with nitre.

 338. Ac-

338. Action of acids on bismuth.

White precipitate—blanc de fard.

339. Bismuth united with sulphur.

340. Bismuth combined with metals.

Uses of bismuth.

Adulteration of mercury.

ZINC.

341. Properties of zinc.

342. Natural history of ores of zinc.

Method of separating the metal.

343. Zinc granulated.

Sublimed.

Inflamed.

Calcined.

Vitrified.

344. Reduction of zinc.

345. Zinc deflagrated with nitre.

356. Action of acids on zinc.

347. Action of sulphur on zinc.

348. Zinc united with metals.

Use of the ores of zinc in the preparation of brass.

Art 340 Bismuth unites with all the Metals except Zinc & Cobalt. — It gives hardness to tin & hence used by the Pewterers — is not to be purified from Mercury wth ease.

Art 341 It is the most malleable of all the metals — was formerly imported from China. —

Art 342. — Zinc will not unite with sulphur unless iron be added & the Zinc be oxydated. — This absence of affinity between Sulph^r & Zinc furnishes a ready method of separating other Metals from Zinc by means of Sulphur

Art 349. they are of a blue colour when fu
with Borax by the blow pipe

Art 354. If this metal be pure its oxide is
brown; if impure, greenish; its calcy
fused with Borax make a glass of
Jaquinth colour. —

Art 408 the oxygen it yields is oxygen
it can be readily reduced to a metal with
ese but an intense heat is necessary
to reduce it perfectly — this oxide fuse
by a blow pipe with phosphate of Soda
upon Charcoal forms a transparent glass
minutely changes from the colour of
a ruby to a colourless state & again becomes
coloured, according to the Quantity of
Phosphate, & to its exposure to the interior

COBALT.

NICKEL.

MANGANESE.

360. Black

360. Black manganese fused with alkali.

361. Effect of black manganese on glass.

362. Reduction of the metal.

TUNGSTEN or WOLFRAM.

363. History of the ore.

Method of obtaining the acid.

Reduction of the metal.

MOLYBDÆNA.

364. Its natural history and properties.

Its acid and reduction.

VEGETABLES.

365. General observations on the structure, growth, and nutriment of vegetables.

The effect of air and light.

366. Analysis of vegetables by fire.

The principles into which they are resolved.

Empyreumatic acids.

Rectification of the empyreumatic oils.

367. Char-

or exterior part of the flame
of this metal from its affinity with oxygen
decomposes water. —

Art. 359. The imperfect oxide is dissolved
by all the Acids; its perfect oxide dissolved
by no Acid so have base or radical
is fully saturated with oxygen & thus in-
capable of taking up more of this prin-
ciple. — Hence the Sulphuric Ether
not act on the perfect oxide of Manganese
without the addition of some sugar
gum or the Oils — its white
precipitate turns brown by heating
it & those from its different solutions
by alkalis become black as they absorb
oxygen. — Report of it fused potts 3 parts of
Nitre & 1 of potash.

Art. 360. The solution of this is at
blue, oxide of Iron separates & finds
yellow colour renders the solution green,
this subsiding the blue re-appears; when
from the oxygen it absorbs from the
air, ye Manganesian oxide becomes reddish
brownish & at last black, when it subsides
leaves the fluid colourless. — solution fused
with potash & a little pump-water is added
to the result in a tall glass the solution
by shaking it is green, by adding more
water, so as to fill the glass the green turns
to a Rose colour & left with distilled water
the colour continues green for the time.

Art 361. by letting away the colour it receives from various impurities when the Mang^e is used in a very small ∴^n — if a ≡ ∴^n be used it gives various hues according to the Quantity & Quality of the oxide. —

Art 363. W^h contains the Metal in the state of an Acid ✱ united with Calcareous Earth is called in this state Tungsten — when there contains Manganese & called Iron + Tungsty + O^d of this Metal it is called Wolfram. —

Art 364. [illegible] Sulphuretted one has a metallic lustre & marks paper similar to plumbago.

Art 364 — is generally found native, having a metallic lustre & greasy feel & marking paper similar to Plumbago

A 365.

The Action

The Action of light separates oxygen from them; during the night they give chiefly out Carbonic Acid Gas — see Ingenhousis experiments on plants. ~~action~~

A 366 Subjected to dry distillation they give out Carbonated hydrogen & Carbonic Acid Gas See Grens Chemistry S. 619 620 — 1, 2, 3, 4

For the principles into w they are resolved see S. 626 — 7 — 8 — 9

For the Acids & oils see do S. 626 — 7 —

The rectification of them S. 631.

Some plants afford no Empyreumatic Acid but Carbonat of Ammonia, hence Azote is a constituent part of them ~~and~~ the ~~[illegible]~~ plants ~~[illegible]~~ yield Ammonia in the ~~[illegible]~~ Decomposition

V. G. S 633 — 4

Art 367 S 636 — 7 — 8 — 9

367. Charcoal.

Attraction of charcoal for air and moiſture.

Action of nitrous acid on charcoal.

Of alkali.

Effects of charcoal on putrid ſubſtances.

368. The alkali obtained from different vegetables.

Salts, &c. in the aſhes of vegetables.

NATURAL PRODUCTS of VEGETABLES.

GUMS.

369. Method of obtaining gums from vegetables.

General properties of gums and mucilages.

SACCHARINE JUICES.

370 Method of extracting them.

Properties of ſaccharine juices.

371. The manufacture of ſugar.

Melaſſes.

Purification and refining.

Cryſtallization.

372. The acid obtained from ſugar.

SALINE

SALINE PRODUCTS.

373. Citric acid.

Method of obtaining and purifying it.

Its properties.

374. Malic acid.

Its production, purification, and properties.

375. Gallic acid.

Its production, purification, and properties.

376. Oxalic acid.

Separation of pure acid from the compound salt.

Its properties.

FIXED OILS.

377. The parts of vegetables which yield the fixed or fat oils.

378. Method of obtaining them.

Their distinguishing qualities.

379. Action of air on them.

Their rancidity.

380. Action of acids.

Method of refining oils.

381. Alkalies

Art 368 – See Gren S 640 – 1 – 2 – 3 – 4 – 5 – 6
7 – 8 – 9.

Art 369 – Gren S. 731 – 2 – 3 – 4 – 5 – 6. –
all made like the acetic Ac by adding oxygen

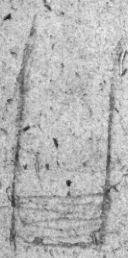
A 370. – Vide abbe Reynal & Gren
from S. 722 to 730
Art. 373. S 696 to 704. –
Art 374. Gren S 705 to 707. –
Art 375 – Gren S 716. to 721.
Art 376 – Gren S 682 to 685. –
Art 377. & S. 754. –
Art 378 vide Gren S. 755 – to 760
Art 379 vide Gren 761 – 2
Art 380 vide Gren 772 to 774

Art 080 by their decomposition they give
Rancidity & Consistence to oils. — A little
Sulphuric Acid is used to purify them
& coagulate the mucilage contained
in expressed oils

Art 381. — Both Alkalis & Acids seem to have the effect upon of oils of rendering them soluble in Water & Spirits of Wine

N. B. O for all fragrant Vegetables

Art. 383.



in from alembic

389. History of camphor, and method of obtaining it from vegetables. S 801 - 2 - 3

Rough camphor refined.

390. The odorous principle of vegetables. S 795

odorous resins

BALSAMS and RESINS.

391. General properties of balsams and resins.

Distinctions between them. S. 737 - 8 - 9 - 40 - 41.

392. Benzoin. S 709 - 10 - 11 - 12 - 13 - 14 - 15.

Essential salts, or acid of benzoin, obtained by solution and crystallization.

By sublimation.

Residuum.

393. Benzoin dissolved in spirits of wine.

Precipitated by water.

394. Turpentine.

Distillation of essential oil.

Common resin.

395. Turpentine combined with potash. S. 777

Starkey's soap.

396. Pitch. S. 652.

Lamp-black.

Tar.

397. Essential

Art 391 they are dried juices of plants, & are soluble in Spirits of Wine, the former are odorous, the latter not. —

Art 392 contains an acid wh may be obtained by sublimation; it goes by the name of flowers of Benzoin. —

Art. 394. Turpentine is a balsam consisting of an essential oil (the Spirits of Turpentine) & a resin, the former being seperated from the latter by distillation

Art 398. Resins dissolved in fixed oils form the fat oily varnish; in volatile oils the essential Varnish; & in alcohol the spirit varnish. —

Art 399. is an inspissated juice, not soluble in spirits of wine but soluble in æther. — when it is procured from the tree by exsersion, it is a milky substance fluid

Its radicals are Hydrogen, carbon, Oxygen vide Lynn § 777 to 781. —

Art 401.

a flannel dipped in cochineal one and ~~dry~~ soaked in a mordant of tin dissolved in Nitro-Muriatic Ac the other not — the former on ~~being~~ washing the flannel continued of a deep scarlet colour w the other faded away

Lakes are mixtures of calcareous or argillaceous Earths with the mucilaginous colouring Matter of Vegetables.

Bleaching see Index S. 854 to 856.—

Art 403

Naphtha S 1106-9

Petroleum } 1110-15

Barbadoes }

Asphaltum from the sea of Sodom & Gomorrah

S 1116 - to 1120.

Art 404 Natural Bitumens are not soluble in Spirits of wine artificial, are

Art 405 supposed by some to be Asphaltum sufficiently hardened to admit of grinding & polishing - *

397. Essential oil of tar.

Tar water. not ab = value of the for other purposes

398. Varnishes.

399. Elastic gum. Other dist

GUM RESINS.

400. Their distinguishing properties. Jol in 5742. —

COLOURING MATTER of VEGETABLES.

401. Dying. Gren S. 823 to 835.

Lakes. S 851 – 2 – 3

BITUMENS. from Mr Hey Gering on a oily nature

402. Properties of bitumens in general.

403. Natural history of bitumens. S 1106 – 9

Naptha, Petrolium, Barbadoes tar, Asphaltum. in sea

404. Analysis of bitumens. Gren S. of Sidon & Gom

Method of distinguishing natural from artificial bitumens.

405. Jet.

406. Pit-coal. S 1121 to 1130. —

Examination of coal by distillation.

407. Amber. S. 1131 to 1140. – 9 – 50

Analysed by distiliation.

Acid of amber.

Oil of amber. + ammonia

Residuum.

408. Ammonia combined with oil of amber.

Eau de luce.

409. Amber examined by menſtrua.

Amber varniſh.

FARINA.

410. Separation of farina by waſhing

Mucilage.

Starch.

Gluten.

SPONTANEOUS DECOMPOSITION of VEGETABLES.

The VINOUS FERMENTATION.

411. The vegetable ſubſtances, which are ſubject to vinous fermentation.

412. Circumſtances neceſſary to fermentation.

Phænomena of the proceſs.

Carbonic acid air.

Spirituous liquor.

Lees.

413. The nature of ferments.

Yeſt, leaven.

Bread.

414. Effects

Art 410. If you wash wheaten flour kneaded into a paste, with care, you obtain mucilage, & Starch, the former of wh is suspended in the water & the latter, ~~at the bottom of it~~ - mucilage is devoid of taste & smell not sol. in pure water but sol in cold as well as hot water & is coagulable by weak Acids & metallic solutions v Lyon 731-3-4-5-6 Starch not sol in pure water of mine or cold water in the latter circumstance it differs from mucilage agreeing with it in being sol in hot water v. Lyon 3 747-50 - if the wheaten flour ~~wheaten~~ has been made into a paste be washed till no more colour remains there is left a substance tenacious & contractile like a membrane called Gluten when dried & burnt it curls like an animal substance not sol in cold water either hot or cold & thus differs from Mucilage & Starch also its products are different as Carbonic & Ac & Hydrogen Gas Empyreumatic oil &c

yields ammonia viz: has Azote in its composition in this & many other Conditions it resembles an animal substance wheat flour appears to contain more of this gluten than any other flour substance. The Mucilage it takes the vinous fermentation. The Starch, the Acetous, the Gluten the putrefactive — vide Lecture 5744 — 5 — 6. ——

Theory of Vinous Fermentation See Lecture S. 1038 — to S. 1040. ——

Art 411, 412, 414 } 9968 to 979

Art 413 9980 — 1 1078 — 90

Malting & making Beer to be found in Green 9 982 to 984. —

Art 415 ~~Alc~~ No Alcohol will distil off without Ebullition: —

Art 415, 416 } 9985 to 1013

414. Effects of checking the fermentation in different parts of the proceſs.

415. Diſtillation of the fermented liquor.

Ardent ſpirit.

Reſiduum.

Different ſorts of ardent ſpirits.

416. Rectification of ſpirit of wine.

Specific gravity of mixtures of ſpirit of wine and water.

Proof ſpirit, and method of eſtimating the ſtrength. best method

Properties of alkohol.

417 Action of acids on alkohol. S. 1014 to 1037

Æther.

418. The nature of wine lees. S. 655 – 6 – 7 – 8

Crude tartar. from faces of Wine

Cream and cryſtals of tartar.

419. Alkaline ſalt obtained from tartar. S. 659.

420 Method of obtaining the pure tartaric acid. S 668-9

421. Tartaric ſoda—ol. Rochelle ſalt. S 665-71

422. Tartaric potaſh—ol. ſoluble tartar. S 664

The ACETOUS FERMENTATION. requires Ht. 90°

423. Circumſtances in which this fermentation differs from the vinous.

Pro-

Production of vinegar. Gm 1042—3 to 46 & to 62

424. Vinegar putrified by diſtillation. S. 1053 to 55

Concentrated.

425. Acetous potaſh—ol. foliated tartar. S 1061

426. Acetous ammonia—ol. ſal mindereri. S 1063

427. Decompoſition of acetous ſalts by heat.

Or by ſulphuric acid.

Acetic acid—ol. radical vinegar.

The PUTRID FERMENTATION.

428. Phænomena. S. 1081 to 1103

Examination of putrified vegetables.

429. Obſervations on the three ſtages of fermentation.

430. Methods of reſtraining fermentation, and preſerving vegetables.

ANIMAL SUBSTANCES.

431. General obſervations on the ſtructure, growth and nutriment of animals.

432. Analyſis of animal ſubſtances by diſtillation

433. Rectification of the empyreumatic oil.

Dippel's animal oil.

434. Diſtillation of horns.

Spirit of hartſhorn. ammonia combined with a little animal oil

435. The

Art 424 } 1056-7-8-9.-
427

by Distill ammonia, N^o oil
dark coal

Art 431 - The great distinction betwee
animal & vegetable Substances is
that that the former contain more
Azote & Phosphorus the latter more
Carbon Hydrogen & Oxygen

431-
432
433
434
436
449

Lyon 857 to 871

Art 435 This Acid when rectified with care seems to differ only from the Acetic Acid by a little animal oil contained in it.—

Art 440 Gs 917 to 922 – differs from other animal, in ~~the~~ yielding no ammonia

The Sebacic Acid seems, when purified, to differ in little or no respect from Acetic Acid. —

† seems to differ only from † Acetic A by a little animal oil con in it

435. The oil and acid of ants.

436. Comparison of the products of vegetable and animal substances by distillation.

437. Resolution of blood into serum and crassamentum.

438. The serum coagulated by heat, by acids, and by spirit of wine.

Action of nitrous acid on serum.

439. The crassamentum separated by washing.

The colouring matter of blood.

Change of colour.

Properties of the fibrous part.

440. The fat of animals.

Action of acids on fat.

Sebacic acid. destined for other acids

441. Of wax and spermaceti. G S. 920

442. The membranes and cartilagenous parts of animals.

Mucilage extracted by boiling. S. 914—15.

Glue, isinglass, &c. S. 916

443. The component parts of muscles.

444. Milk analyzed by distillation.

Coagulum, and fermentation by heat.

445. Coagulum by acid, and separation of whey from the caseous part.

Cream,

Cream, butter.

Acid and ſugar of milk.

446. The fæces.

Ambergris.

447. Urine.

The ſediment, and calculus.

Acid obtained from calculus.

448. Freſh or putrid urine evaporated.

Salts obtained.

Kunckel's phoſphorus.

449. Analyſis of the ſolid parts of animals.

Bones and horns diſtilled.

450. Phoſphorus obtained from bones.

Rectification of phoſphorus.

451. Phoſphorus combined with ſulphur.

Diſſolved in ſpirits of wine, æther, oils, &c.

452. Action of nitrous acid on phoſphorus.

Of alkali.

453. Phoſphoric acid by ſeveral methods.

Its combinations with various ſubſtances.

Phs Bones Sol in Nitric Ac + Sul
Ac gelatine by allowing it to deposit
remains a concrete sub — being PA
a deliquescent glass + &c.

pure Ac of P deliquesces, fine green flame
light of tin turns Phos black

Art 148 The salts at 1st obtained by evaporating putrid Urine are very impure; the Microcosmic salt is obtained w is Phosc Acid combined with Ammonia & Soda (Phosphoric Soda fuses with the blow pipe to a hard glass; the Microcosmic salt remains soft; this may be obtained by adding Phosphc Ammonia to Phosc Soda) afterwards a thick mass resembling honey is obtained w is to be mixed with Charcoal & distilled in order to produce Phosphorous. —

Phos ~~combs w Lime burns by pattering~~
at in Wr w ~~seems to be decomposed~~

~~by Combustion w is seen under Wr~~

Ste^m freezes at between 39 & 40 degrees below 0 of Fah^t
boils at 600 above 0

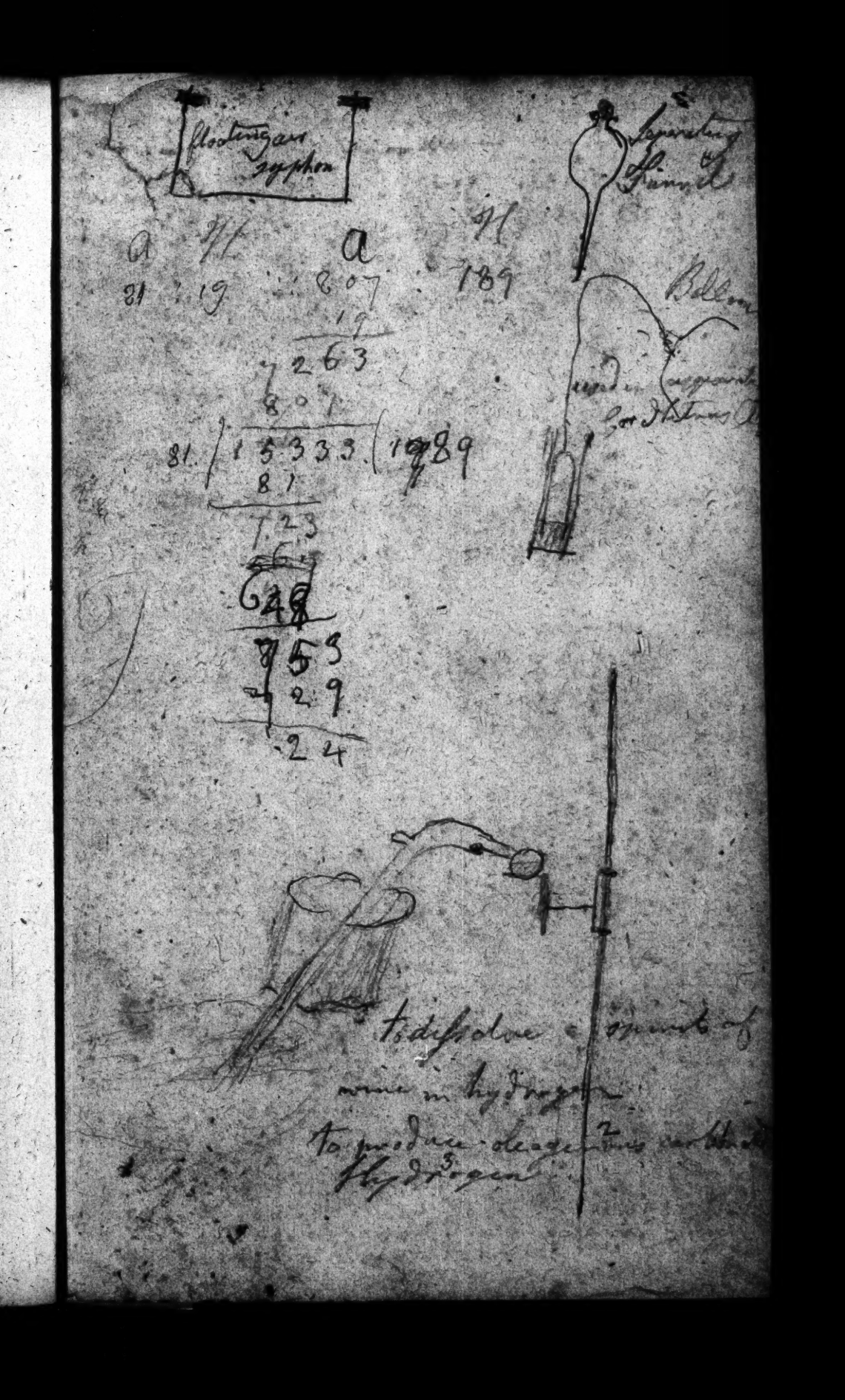
22 09

Ste^m Mamales frame used in the freezing of
Mr^ny

ground ice 22 09

A Lady in Lower Austria f^rom Yearly
report

19 f^rom 0 of Mr^ny p^er 1d
before sunrise


floating gas syphon
Separating funnel
Balloon
to dissolve a quantity of
water in hydrogen
to produce oleagenous carbonated
Hydrogen